UNEP OzonAction

Review of policy measures and incentives for ozone- and climate-friendly technologies

Atmosphere Europe Conference

Brussels, Belgium, 11-12 October 2011

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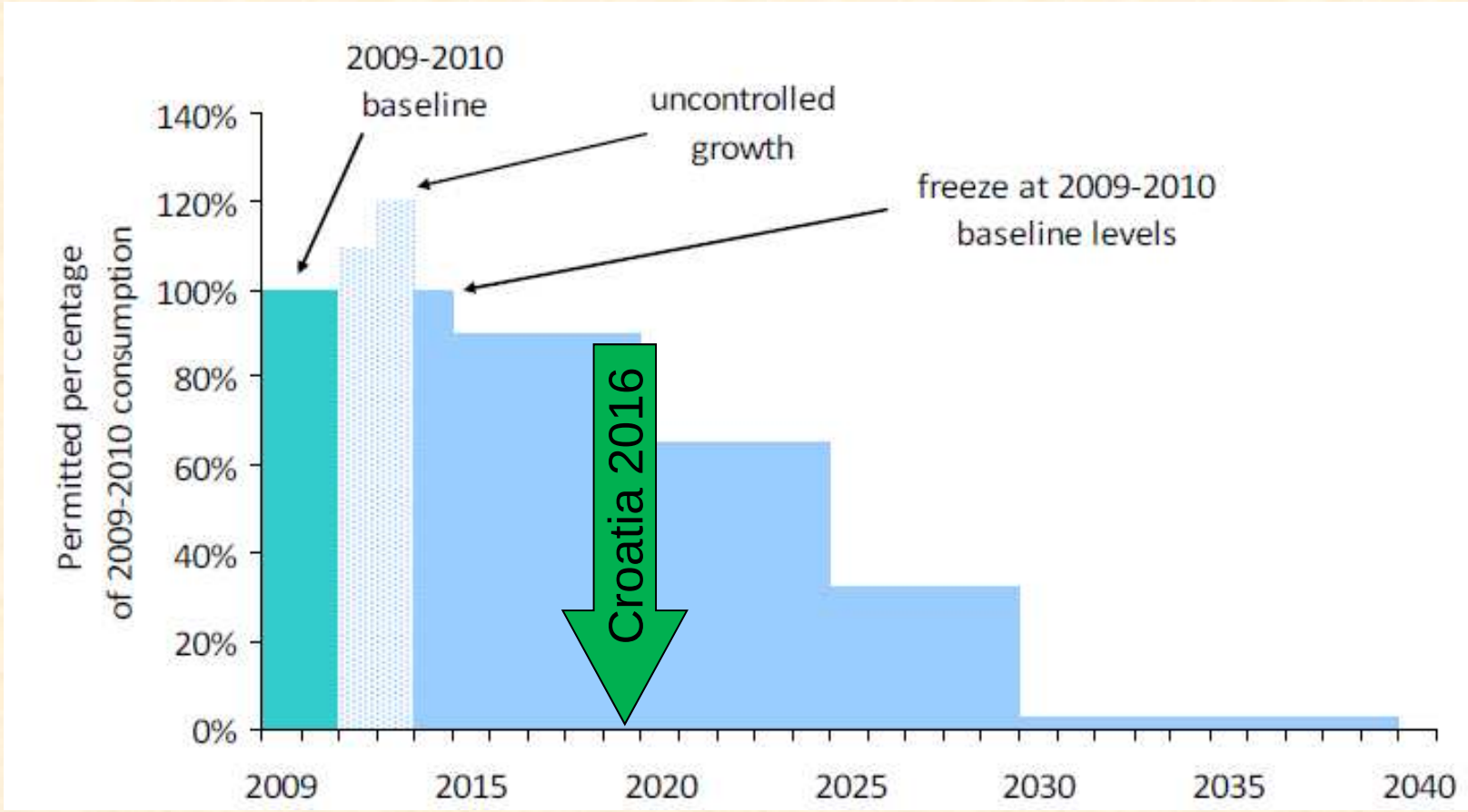
Regional Ozone Network for Europe & Central Asia

UNEP DTIE OzonAction Programme

Montreal Protocol HCFC phase-out schedule for Article 5 countries



Montreal Protocol HCFC phase-out

- **Ozone protection and additional climate benefits**
  - HCFC phase-out strategies for 148 developing countries
  - Direct GWG emissions from refrigerant leakage
  - Indirect GWG emissions from energy use
- **Meeting of the Parties Decision XIX/6 (2007)**
  - minimize environmental and climate impacts and meet other health, safety and economic considerations
- **Executive Committee Decision 60/44 (2010)**
  - Up-to 25% additional funding for climate-friendly technologies

Regional Ozone Network for Europe & Central Asia

Regional Ozone Network for Europe & Central Asia

12 developing countries

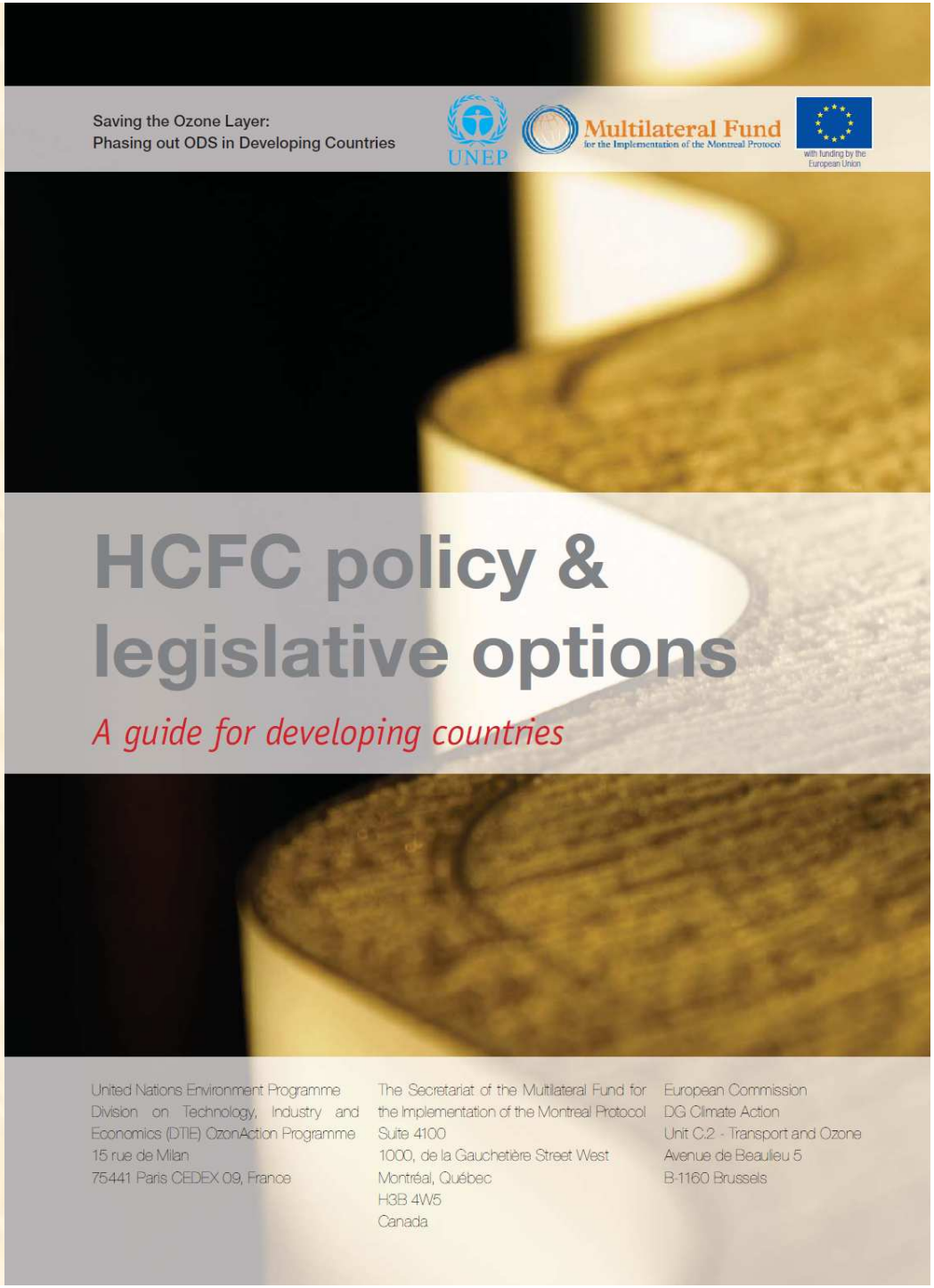
- Albania
- Armenia
- Bosnia & Herzegovina
- Croatia
- Georgia
- Kyrgyzstan
- Macedonia FYR
- Moldova
- Montenegro
- Serbia
- Turkey
- Turkmenistan

7 associated CEIT countries

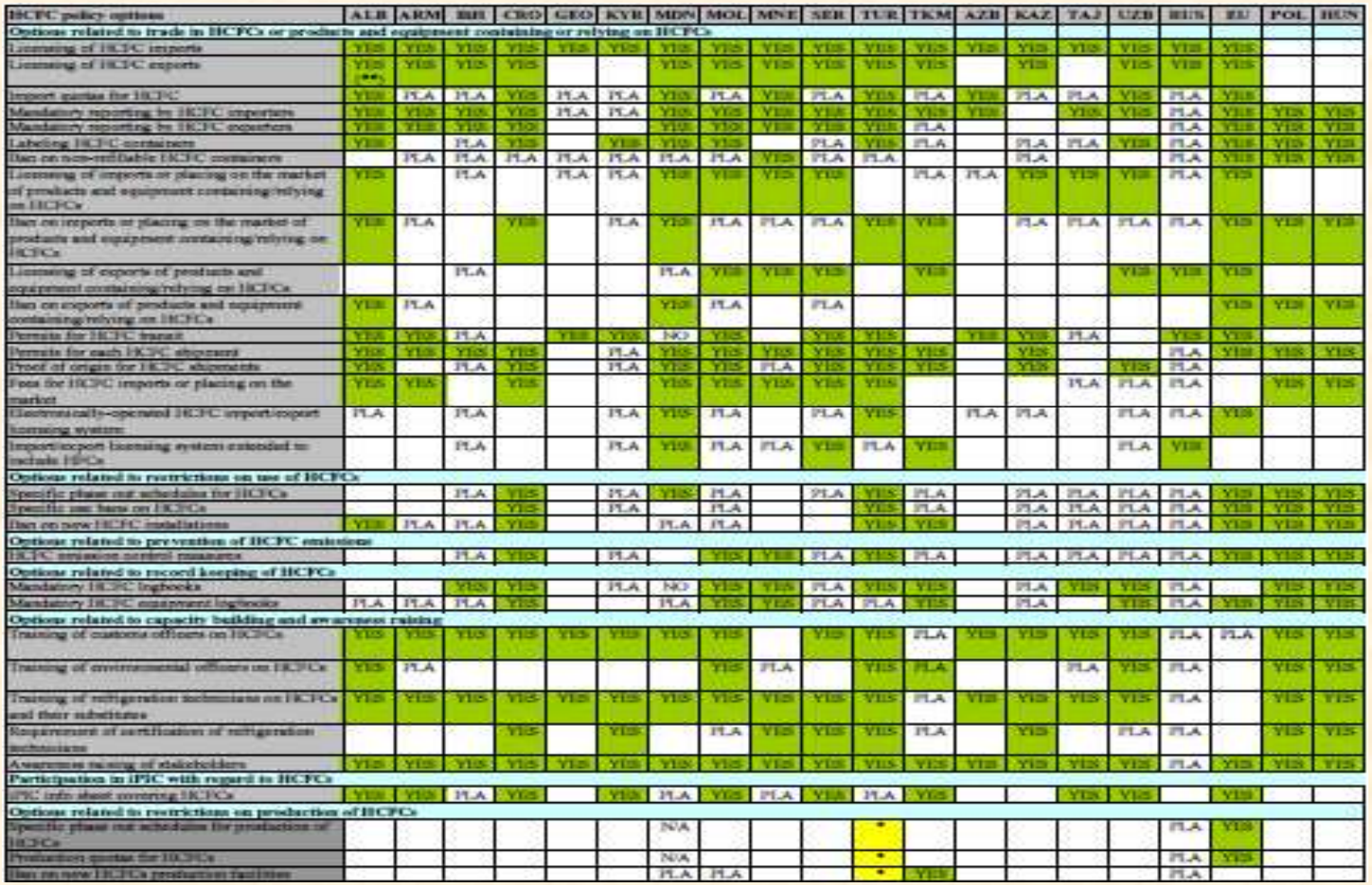
- Azerbaijan
- Belarus
- Kazakhstan
- Russian Federation
- Tajikistan
- Ukraine
- Uzbekistan

Guide on HCFC policy & legislative options for developing countries

Regional Ozone Network for Europe & Central Asia
Compliance Assistance Programme



HCFC policy measures



HCFC policy options	ALB	ARM	BIH	CRO	GEO	KYR	MDN	MOL	MNE	SER	TUR	TKM	AZB	KAZ	TAJ	UZB	BLRS	EU	POL	HUN
Options related to trade in HCFCs or products and equipment containing or relying on HCFCs																				
Licensing of HCFC imports	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES		
Licensing of HCFC exports	YES (**)	YES	YES	YES			YES	YES	YES	YES	YES	YES		YES		YES	YES	YES		
Import quotas for HCFC	YES	PLA	PLA	YES	PLA	PLA	YES	PLA	YES	PLA	YES	PLA	YES	PLA	PLA	YES	PLA	YES		
Mandatory reporting by HCFC importers	YES	YES	YES	YES	PLA	PLA	YES	YES	YES	YES	YES	YES	YES		YES	YES	PLA	YES	YES	YES
Mandatory reporting by HCFC exporters	YES	YES	YES	YES			YES	YES	YES	YES	YES	PLA					PLA	YES	YES	YES
Labeling HCFC containers	YES		PLA	YES		YES	YES	YES		PLA	YES	PLA		PLA	PLA	YES	PLA	YES	YES	YES
Ban on non-refillable HCFC containers		PLA	PLA	PLA	PLA	PLA	PLA	PLA	YES	PLA	PLA			PLA			PLA	YES	YES	YES
Licensing of imports or placing on the market of products and equipment containing/relying on HCFCs	YES		PLA		PLA	PLA	YES	YES	YES	YES		PLA	PLA	YES	YES	YES	PLA	YES		
Ban on imports or placing on the market of products and equipment containing/relying on HCFCs	YES	PLA		YES		PLA	YES	PLA	PLA	PLA	YES	YES		PLA	PLA	PLA	PLA	YES	YES	YES
Licensing of exports of products and equipment containing/relying on HCFCs			PLA				PLA	YES	YES	YES		YES				YES	YES	YES		
Ban on exports of products and equipment containing/relying on HCFCs	YES	PLA					YES	PLA		PLA								YES	YES	YES
Permits for HCFC transit	YES	YES	PLA		YES	YES	NO	YES		YES	YES		YES	YES	PLA		YES	YES		
Permits for each HCFC shipment	YES	YES	YES	YES		PLA	YES	YES	YES	YES	YES	YES		YES			PLA	YES	YES	YES
Proof of origin for HCFC shipments	YES		PLA	YES		PLA	YES	YES	PLA	YES	YES	YES		YES		YES	PLA			
Fees for HCFC imports or placing on the market	YES	YES		YES			YES	YES	YES	YES	YES				PLA	PLA	PLA		YES	YES
Electronically-operated HCFC import/export licensing system	PLA		PLA			PLA	YES	PLA		PLA	YES		PLA	PLA		PLA	PLA	YES		
Import/export licensing system extended to include HFCs			PLA			PLA	YES	PLA	PLA	YES	PLA	YES				PLA	YES			
Options related to restrictions on use of HCFCs																				
Specific phase out schedules for HCFCs			PLA	YES		PLA	YES	PLA		PLA	YES	PLA		PLA	PLA	PLA	PLA	YES	YES	YES
Specific use bans on HCFCs				YES		PLA		PLA			YES	PLA		PLA	PLA	PLA	PLA	YES	YES	YES
Ban on new HCFC installations	YES	PLA	PLA	YES			PLA	PLA			YES	YES		PLA	PLA	PLA	PLA	YES	YES	YES
Options related to prevention of HCFC emissions																				
HCFC emission control measures			PLA	YES		PLA		YES	YES	PLA	YES	PLA		PLA	PLA	PLA	PLA	YES	YES	YES
Options related to record keeping of HCFCs																				
Mandatory HCFC logbooks			YES	YES		PLA	NO	YES	YES	PLA	YES	YES		PLA	YES	YES	PLA		YES	YES
Mandatory HCFC equipment logbooks	PLA	PLA	PLA	YES			PLA	YES	YES	PLA	PLA	YES		PLA		YES	PLA	YES	YES	YES
Options related to capacity building and awareness raising																				
Training of customs officers on HCFCs	YES	YES	YES	YES	YES	YES	YES	YES		YES	YES	PLA	YES	YES	YES	YES	PLA	PLA	YES	YES
Training of environmental officers on HCFCs	YES	PLA						YES	PLA		YES	PLA			PLA	YES	PLA		YES	YES
Training of refrigeration technicians on HCFCs and their substitutes	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	PLA	YES	YES	YES	YES	PLA		YES	YES
Requirement of certification of refrigeration technicians				YES		YES		PLA	YES	YES	YES	PLA		YES		PLA	PLA		YES	YES
Awareness raising of stakeholders	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	PLA	YES	YES	YES
Participation in PIC with regard to HCFCs																				
PIC info sheet covering HCFCs	YES	YES	PLA	YES		YES	PLA	YES	PLA	YES	PLA	YES			YES	YES		YES		
Options related to restrictions on production of HCFCs																				
Specific phase out schedules for production of HCFCs							N/A				*						PLA	YES		
Production quotas for HCFCs							N/A				*						PLA	YES		
Ban on new HCFCs production facilities							PLA	PLA			*	YES					PLA			

Review of HCFC policy measures (1)

- **Monitoring & control of trade**
  - ➢**17 in place** (out of 17 countries)
- **Mandatory reporting by importers / exporters**
  - ➢**13 in place, 3 planned** (out of 17 countries)
- **Labeling requirements for containers**
  - ➢**7 in place, 6 planned** (out of 17 countries)
- **Ban of non-refillable containers**
  - ➢**1 in place, 11 planned** (out of 17 countries)

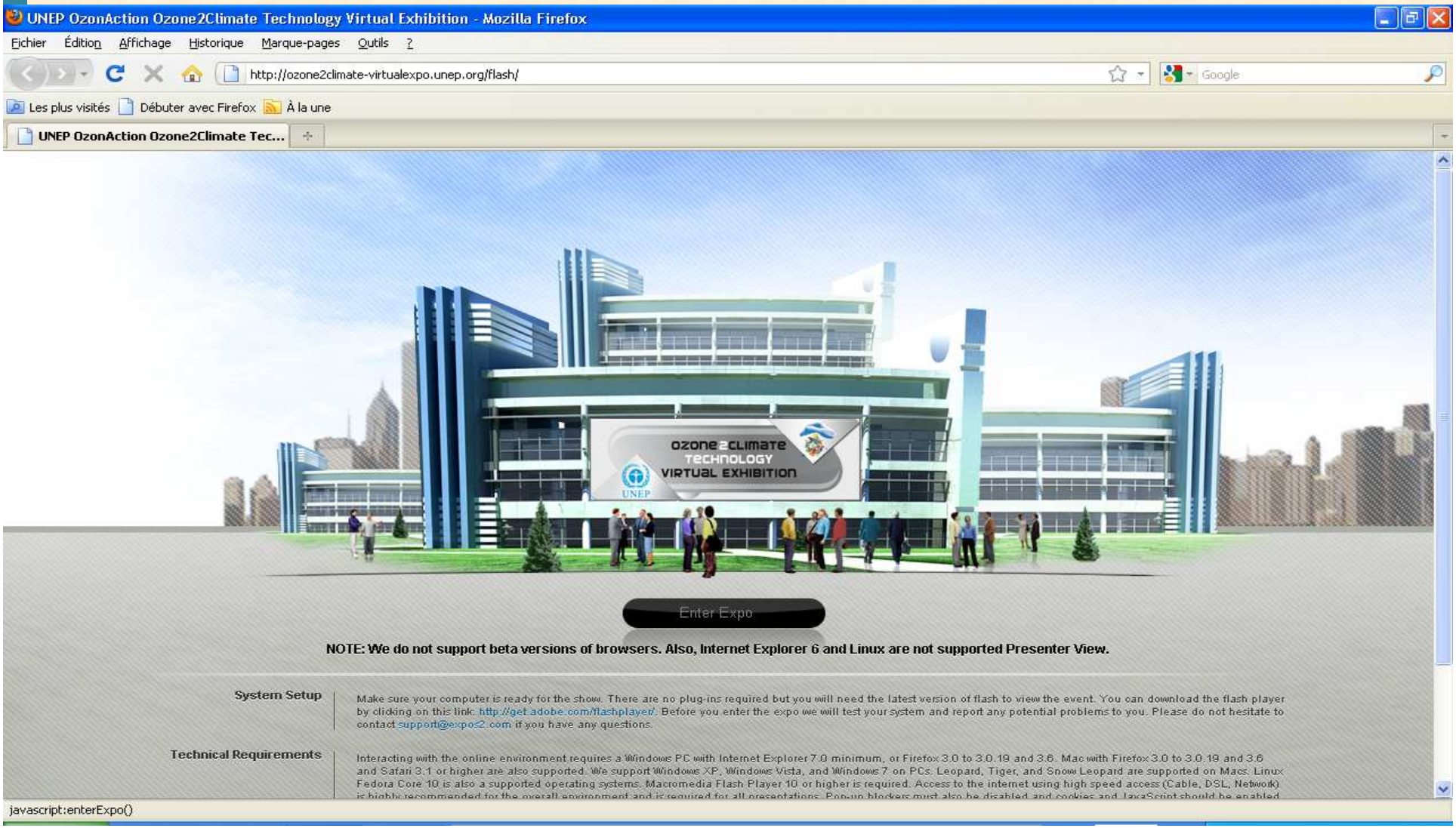
Review of HCFC policy measures (2)

- **Control of trade in equipment / products**
  - **11 in place, 6 planned** (out of 17 countries)
- **Proof of origin of imports**
  - **9 in place, 4 planned** (out of 17 countries)
- **Import and placing on the market fees**
  - **8 in place, 3 planned** (out of 17 countries)
- **Licensing system extended to HFCs**
  - **4 in place, 6 planned** (out of 17 countries)

Review of HCFC policy measures (3)

- **Ban on new installation**
  - **4 in place, 8 planned** (out of 17 countries)
- **Emission control measures**
  - **4 in place, 8 planned** (out of 17 countries)
- **Mandatory record keeping**
  - **8 in place, 7 planned** (out of 17 countries)
- **Certification of refrigeration technicians**
  - **6 in place, 4 planned** (out of 17 countries)
- **Informal Prior Informed Consent (iPIC)**
  - **10 in place, 4 planned** (out of 17 countries)

Virtual exhibition on ozone- and climate-friendly technologies …



Virtual exhibition on ozone- and climate-friendly technologies …

Consultation of National Ozone Units

12 developing countries

- **Albania**
- **Armenia**
- **Bosnia & Herzegovina**
- **Croatia**
- Georgia
- **Kyrgyzstan**
- **Macedonia FYR**
- **Moldova**
- **Montenegro**
- Serbia
- **Turkey**
- **Turkmenistan**

7 associated CEIT countries

- Azerbaijan
- **Belarus**
- Kazakhstan
- **Russian Federation**
- **Tajikistan**
- Ukraine
- **Uzbekistan**

14 responses received in time

5 responses not yet received

1. Manufacturing of RAC equipment and heat pumps ?

8 yes / 6 no (mainly HFCs)

A5 countries	Y/N	Comments
Albania	No	
Armenia	Yes	Commercial refrigeration equipment, conversion to hydrocarbon planned
Croatia	No	Assembly
Bosnia Herzeg.	Yes	AC and refrigeration equipment, heat pumps
Kyrgyzstan	No	Assembly
Macedonia FYR	Yes	Geothermal heat pumps (up to 30 kW), refrigeration split units (HFC)
Moldova	No	
Montenegro	Yes	Horizontal freezer (R134a) and pre-mixed polyoil
Turkey	Yes	
Turkmenistan	No	
CEIT countries		
Belarus	Yes	AC and refrigeration equipment
Russian Fed.	Yes	
Tajikistan	No	
Uzbekistan	Yes	Household refrigerators (R134a) , commercial refrigeration equipment (R22, R134a), assembly

2. Ozone- & climate-friendly technologies ?

12 yes / 1 no (mainly NH3, HC, CO2 but also HFCs)

A5 countries	Y/N	Comments
Albania	Yes	
Armenia	No	Ammonia systems are obsolete and subject to replacement
Croatia	Yes	Ammonia plants in meat, brewery, dairy and fruit industry
Bosnia Herzeg.	Yes	Conversion from R11 to n-pentane and cyclopentane
Kyrgyzstan	Yes	Heat pumps, cold rooms, chillers and supermarket refrigeration (R404a, R134a)
Macedonia FYR	Yes	Ammonia plants in breweries, cold stores, meat processing plants, new meat plant (NH3/CO2), household refrigerators (R600a)
Moldova	Yes	CFCs are banned and HFCs are widely used
Montenegro	Yes	Small number of ammonia installations
Turkey	Yes	
Turkmenistan		
CEIT countries		
Belarus	Yes	Conversion from R-11, R-12 to R600a, cyclopentane and ammonia
Russian Fed.	Yes	
Tajikistan	Yes	
Uzbekistan	Yes	Polyurethane foam insulation for domestic refrigerators (cyclopentane) , polystyrene sandwich panels (water vapor)

3. Heat pumps and refrigerants used ?

10 yes / 2 no (mainly HFC and HCFCs)

A5 countries	Y/N	Comments
Albania	No	
Armenia	Yes	Air-to-air and some water-to-water heat pumps (R407c, R410a)
Croatia	Yes	Heat pumps increasingly used in residential applications, industry and hotels (R407c, R410a)
Bosnia Herzeg.	Yes	Heat pumps (R22, R407c, R410a)
Kyrgyzstan	Yes	Heat pumps (R134a , R407)
Macedonia FYR	Yes	Air/water heat pumps for residential cooling/heating, few geothermal heat pumps (R22, R407c, R410a)
Moldova	No	Only at the Technical University for training purposes
Montenegro	Yes	Heat pumps (R22, HFCs)
Turkey	Yes	Heat pumps (HFCs)
Turkmenistan		
CEIT countries		
Belarus	Yes	Imported heat pumps (R134a, R404a, R407C, R410A, R290)
Russian Fed.	Yes	Nibe, Waterkotte, Rehau, Mammoth heat pumps (R407a, R410a)
Tajikistan	Yes	Heat pumps with R22 (93-95 %) or R134a, R-407c, R410a (5-7 %)
Uzbekistan		

4. Economic incentives for heat pumps?

0 yes / 14 no

A5 countries	Y/N	Comments
Albania	No	
Armenia	No	
Croatia	No	Ministry developed grant scheme but economic crisis stopped it
Bosnia Herzeg.	No	
Kyrgyzstan	No	
Macedonia FYR	No	
Moldova	No	
Montenegro	No	
Turkey	No	
Turkmenistan	No	
CEIT countries		
Belarus	No	
Russian Fed.	No	
Tajikistan	No	
Uzbekistan	No	

5. Not-in-kind technologies used ?

8 yes / 5 no

A5 countries	Y/N	Comments
Albania	No	
Armenia	No	
Croatia	Yes	
Bosnia Herzeg.	No	
Kyrgyzstan	No	Possibly used in laboratories
Macedonia FYR	Yes	Few computer and IT rooms with free cooling
Moldova		
Montenegro	No	
Turkey	Yes	Few absorption systems
Turkmenistan	Yes	
CEIT countries		
Belarus	Yes	
Russian Fed.	Yes	
Tajikistan	Yes	Stations of switchboards, base stations in high mountains, 4-5 months of ventilation
Uzbekistan	Yes	Cooling with ice in rural highland areas, ventilation in cotton plants, product storage using insulation and shading

6. Renewable energies used ?

13 yes / 0 no (wind, solar, geothermal, hydro …)

A5 countries	Y/N	Comments
Albania	Yes	
Armenia	Yes	Wind farms, solar water heating systems
Croatia	Yes	Geothermal heat pumps, solar collectors and solar panels
Bosnia Herzeg.	Yes	Geothermal energy for room and pool heating, solar energy for sanitary water, small hydro power and solar heating plants, new constructions
Kyrgyzstan	Yes	Geothermal and solar energy in domestic, hotel and industry sectors
Macedonia FYR	Yes	Geothermal energy in agricultural sector, solar energy mainly in domestic sector for sanitary hot water
Moldova	Yes	Japanese project on solar energy
Montenegro	Yes	Solar energy is competency of Ministry of Economy
Turkey	Yes	
Turkmenistan		
CEIT countries		
Belarus	Yes	Geothermal energy for greenhouses, solar water heaters, hydro power, boilers with wood fuel, biogas and landfill gas systems, wind power
Russian Fed.	Yes	Pilot plants
Tajikistan	Yes	Few solar power plants for hot water, wind electro generators combined with batteries
Uzbekistan	Yes	Solar energy (high potential), hydro power demonstration projects in small streams, potential for geothermal energy

7. Certification scheme for servicing companies ?

7 yes / 2 partly / 5 no

A5 countries	Y/N	Comments
Albania	Yes	
Armenia	No	
Croatia	Yes	Since 1999
Bosnia Herzeg.	No	
Kyrgyzstan	Yes	State licensing system of companies servicing refrigeration equipment
Macedonia FYR	Partly	Legal and natural persons that recover or recycles ODS should posses R&R equipment and at least one trained employee, official certification scheme in line with EU regulation No. 1005/2009 under development
Moldova	No	Planned under HPMP
Montenegro	Yes	Each service company must have a license for service and maintenance
Turkey	No	Service technicians have to comply with some legislative requirements
Turkmenistan	Partly	
CEIT countries		
Belarus	Yes	Repair and maintenance of household electronic equipment, electrical machinery and appliances for the public (including air conditioners) are subject to mandatory certification
Russian Fed.	No	
Tajikistan	Yes	Licensing of companies serving the equipment containing ODS and handling ODS
Uzbekistan	Yes	List of activities associated with installation, maintenance, repair, refrigeration and air conditioning which requires a license

8. Training & certification scheme for technicians ?

6 yes / 4 partly / 3 no

A5 countries	Y/N	Comments
Albania	Yes	
Armenia	No	
Croatia	Yes	Since 2001 - currently the training and certification scheme is being improved according to EU regulations
Bosnia Herzeg.	No	Planned and contracts with the training centers have already been signed
Kyrgyzstan	Yes	Training of refrigeration technicians in the systems of higher and secondary education followed by certification
Macedonia FYR	Yes	Since 2001 - service technicians are certified after attending the training
Moldova	Yes	
Montenegro	Yes	
Turkey		
Turkmenistan	Partly	As part of project implementation
CEIT countries		
Belarus	Partly	Training of refrigeration servicing technicians
Russian Fed.	No	
Tajikistan	Partly	Technical training provided by the RAC association " ЦИХ " - without legal certification
Uzbekistan	Partly	Training is provided on a fee basis

9. Training infrastructure in place ?

12 yes / 1 partly / 1 no

A5 countries	Y/N	Comments
Albania	Yes	
Armenia	Partly	Faculty of Refrigeration, Cryogen Techniques and Conditioning Systems closed - the course partly taken up by the Faculty of Mechanical Engineering
Croatia	Yes	Universities
Bosnia Herzeg.	Yes	Mechanical faculties signed contracts and will be provided with equipment for the training centers
Kyrgyzstan	Yes	National Technical University, vocational schools and colleges
Macedonia FYR	Yes	
Moldova	Yes	Technical University and training centre
Montenegro	Yes	Technical vocational school
Turkey	Yes	
Turkmenistan	Yes	
CEIT countries		
Belarus	Yes	National Technical University, State Universities, State vocational school, College of Technology
Russian Fed.	Yes	
Tajikistan	No	
Uzbekistan	Yes	State Technical University and Technological Institute offering bachelors / masters in refrigeration, college for servicing technicians

10. Labeling schemes in place (ozone, energy) ?

6 yes / 1 partly / 7 no

A5 countries	Y/N	Comments
Albania	Partly	
Armenia	No	
Croatia	Yes	
Bosnia Herzeg.	No	
Kyrgyzstan	Yes	International labeling for energy-saving and ozone-friendly equipment
Macedonia FYR	Yes	Labeling of products containing certain hazardous chemicals, labeling scheme for energy efficiency of appliances
Moldova	No	
Montenegro	Yes	Labeling for ozone-friendly products containing alternative substances (F-gases), energy-efficiency labeling planned
Turkey	Yes	Energy-efficiency labeling for air-conditioners
Turkmenistan	No	
CEIT countries		
Belarus	Yes	"Harmful to Ozone" label on packaging and shipment documents, national energy-efficiency standard of refrigeration (Directive 96/57/EC) and AC devices (Directive 2002/31/ES) – only A+, A or B classes
Russian Fed.	No	
Tajikistan	No	
Uzbekistan	No	

11. Economic incentives / disincentives in place ?

5 yes / 9 no (HCFC phase-out but also HFC phase-in)

A5 countries	Y/N	Comments
Albania	Yes	Environment taxes
Armenia	No	
Croatia	Yes	New Air Protection Act includes provision to co-finance the replacement of ODS and F-gas equipment with ozone- and climate-friendly equipment
Bosnia Herzeg.	No	
Kyrgyzstan	No	
Macedonia FYR	Yes	Law on Environment requires importers of HCFCs to pay 63 MKD (1 euro) per kilogramme HCFC
Moldova	Yes	HFC imports are exempted from ecological taxes
Montenegro	No	
Turkey	No	
Turkmenistan	No	
CEIT countries		
Belarus	Yes	Environmental tax is levied on imported ODS, including those contained in the products
Russian Fed.	No	
Tajikistan	No	
Uzbekistan	No	System of payments for environmental pollution and waste disposal is being amended to include ODS and products containing ODS

12. Incentives for product innovation in place ?

0 yes / 13 no

A5 countries	Y/N	Comments
Albania	No	
Armenia	No	
Croatia		
Bosnia Herzeg.	No	
Kyrgyzstan	No	
Macedonia FYR	No	
Moldova	No	
Montenegro	No	
Turkey	No	
Turkmenistan	No	
CEIT countries		
Belarus	No	
Russian Fed.	No	
Tajikistan	No	
Uzbekistan	No	

13. Bans or quotas for HCFC equipment in place ?

7 yes / 7 no

A5 countries	Y/N	Comments
Albania	Yes	Import of HCFC equipment is banned
Armenia	No	
Croatia	Yes	Import of HCFC equipment is banned since 2006
Bosnia Herzeg.	No	
Kyrgyzstan	No	Quota for HCFC will be introduced in 2015
Macedonia FYR	Yes	Import of HCFC air-conditioners limited to 20.000 units in 2011, from 1 January 2012 the import and export of HCFC products is prohibited
Moldova	No	Planned under HCFC phase-out management plan
Montenegro	Yes	Import of HCFC equipment is banned from 1 January 2012
Turkey	Yes	Import of HCFC equipment is banned since 1 January 2010, quotas apply to HCFC imports, from 2015, only HCFC imported for servicing
Turkmenistan	No	
CEIT countries		
Belarus	Yes	Design, construction, modernization, expansion and technology, equipment, materials and substances that require or contain ODS are restricted or prohibited except facilities for recycling or disposal
Russian Fed.	Yes	
Tajikistan	No	Banning the import of HCFC equipment is under preparation and will be presented to the Government in November 2011
Uzbekistan	No	Bans and quotas are planned as part of the HCFC phase-out plan

14. Linkages to urban planning & housing ?

3 yes / 10 no

A5 countries	Y/N	Comments
Albania	No	
Armenia	Yes	Project on improving energy efficiency in buildings
Croatia	Yes	Certification scheme considering annual building energy needed for heating in the building sector, low and passive energy houses
Bosnia Herzeg.	Yes	Examples in shopping malls, meat industry and in cities
Kyrgyzstan	No	
Macedonia FYR	No	Little coordination between architect and HVAC companies during project design but often no follow-up during construction
Moldova	No	
Montenegro	No	
Turkey		
Turkmenistan	No	
CEIT countries		
Belarus	No	
Russian Fed.	No	
Tajikistan	No	
Uzbekistan	No	

Croatia: Ammonia meat plant

PIK Vrbovec meat plant:

- Cooling area: 25000 m2
- Cooling capacity: 10 MW.

Compared with the old plant:

- **Production tripled**
- **Ammonia charge reduced from 30 to 20 tons**

Turkey: Hydrocarbon display cabinets

PepsiCo display cabinets:

– latest technology with hydrocarbons
– energy management systems
– system optimization
– nation-wide infrastructure and capability of local suppliers

Compared with traditional coolers:

– **Up-to 50% more energy efficient**
– PepsiCo pursues a dual approach keeping both CO2 and hydrocarbon as options open.

Armenia: Conversion to hydrocarbons

SAGA company in Armenia

- sandwich panels
- commercial refrigerators

Alternative technology

- **Cyclo-pentane as blowing agent for the insulation foam**
- **Propane (R290) as refrigerant**

Project impact

- Phase-out of 33 metric tons or 2,2 ODP tons of HCFC

Turkey: HFC/CO2 cascade system

Carrefour supermarket in Istanbul:

– Sales area: 7700 m2

Compared with the type of systems used before:

– **Up-to 40% more energy efficient**
– **Saving 40 MWh per year**

Recent installations in Kyrgyzstan

Cold store for dairy products

Power 150 KW

R 404a

Cold store for meat products

Power 270 KW

R 404a

Cold store for vegetables

Power 94 KW

R134a

Recent installations in Kyrgyzstan

Chiller in hydrogen recovery factory
Power 32 KW
R404a
2009

Chiller in air separation factory
Power 47 KW
R404a
2009

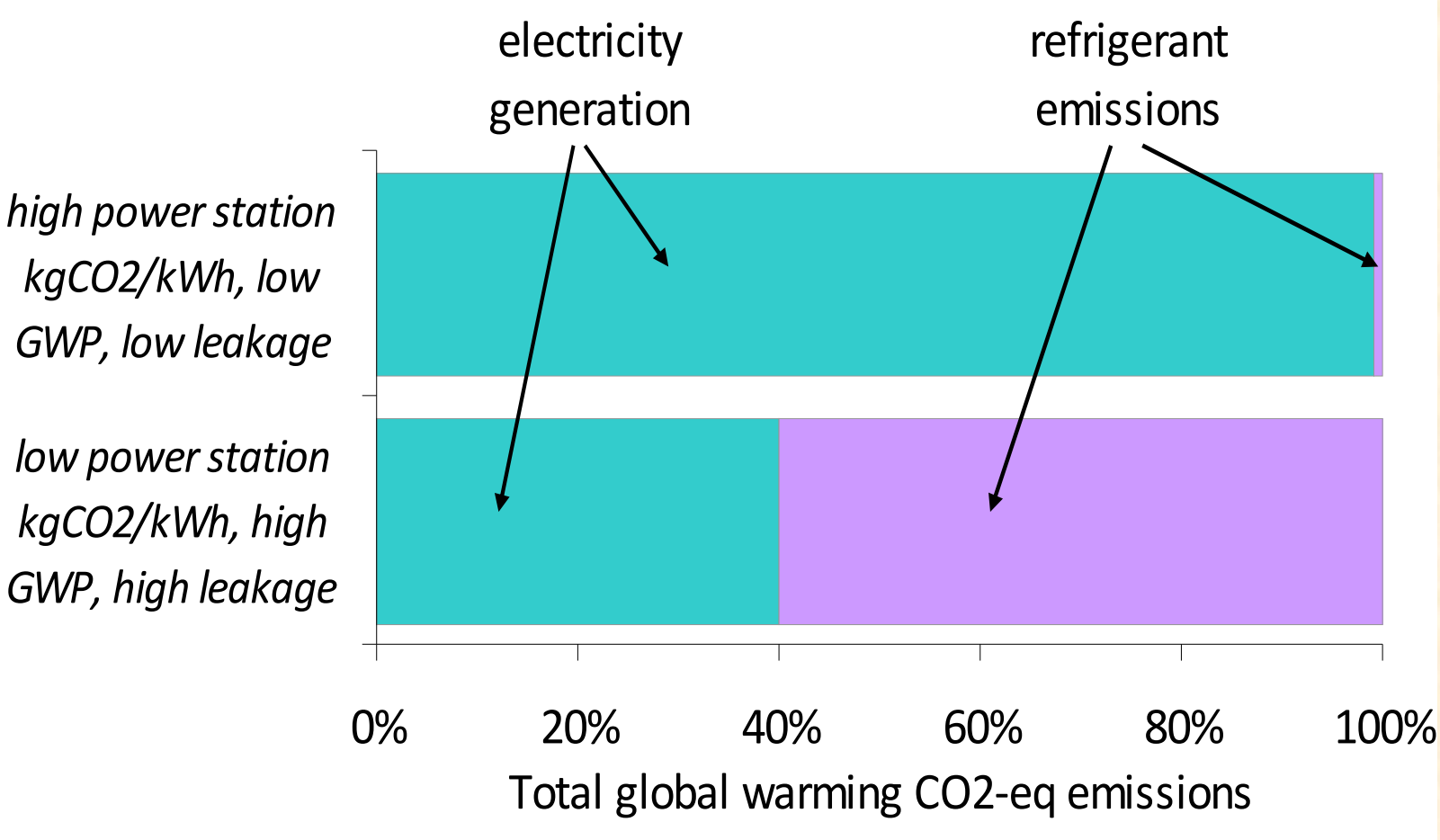
Refrigerating plant at supermarket
Medium temperature
Power 224 KW
R404a
Low temperature
Power 48 KW
R404a

Conclusion

- HFC technologies prevailing
- Barriers to natural refrigerants
- Policy setting for HCFC phase-out
- No incentives for natural refrigerants / heat pumps
- No linkages to urban planning
- Policy options not used to their full potential
- Technology information is crucial
- Private sector cooperation important
  - RAC associations
  - Multinationals

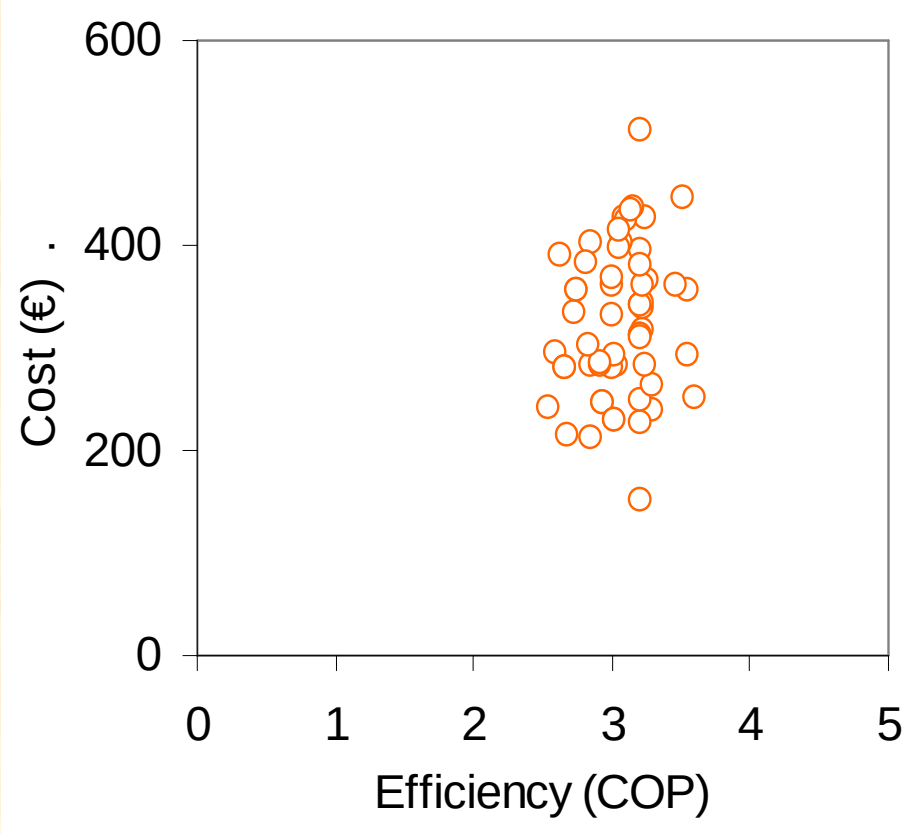
Energy use & refrigerant emissions

[Colbourne, 2009]



Energy efficiency & costs

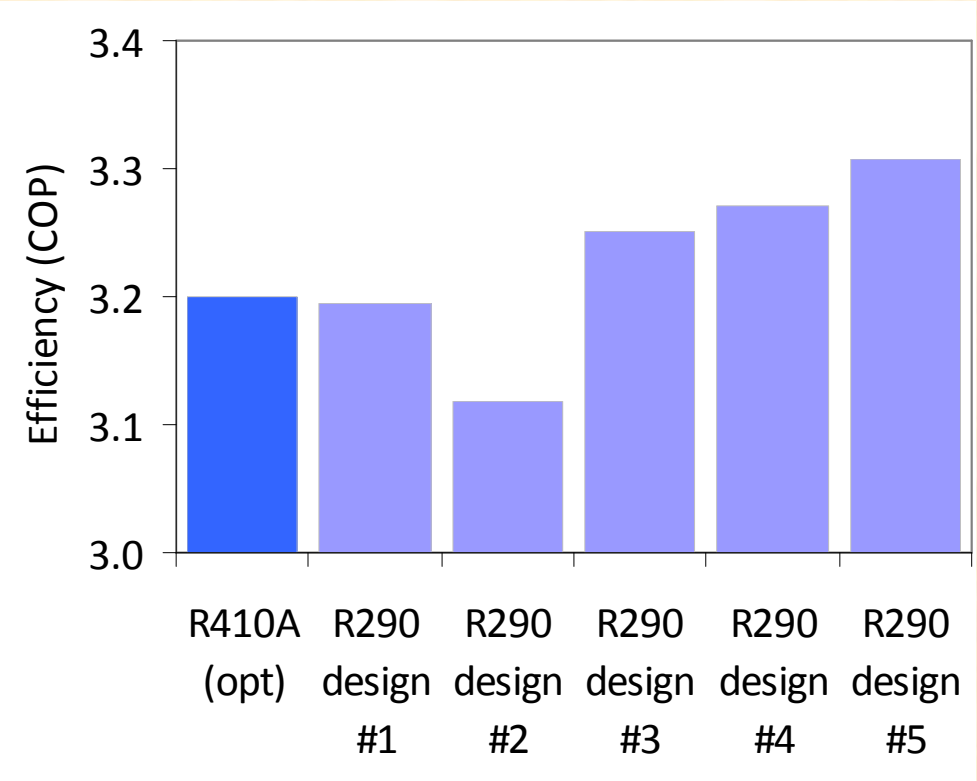
[Colbourne, 2009]



- Similar split AC systems from different producers
  - For same cost, efficiency varies by ±50%
  - For same efficiency, cost varies by ±100%
- Efficiency not related to price
- Importance of standards & labelling

Energy efficiency & refrigerant choice

[Colbourne, 2009]



- In well designed systems using different refrigerants, efficiency may vary ±10%
- Between poorly and well designed systems using the same refrigerant, energy efficiency may vary ±50%
- Hydrocarbons, CO2 and ammonia have better properties than fluorocarbons

•GEA Grasso recently launched its BluAstrum ammonia chiller which was awarded by German Refrigeration Prize in the category "Clim

German Refrigeration Prize

Prize in the category "Climate-Friendly Use of Refrigeration Systems in Production of Foods and Beverages"

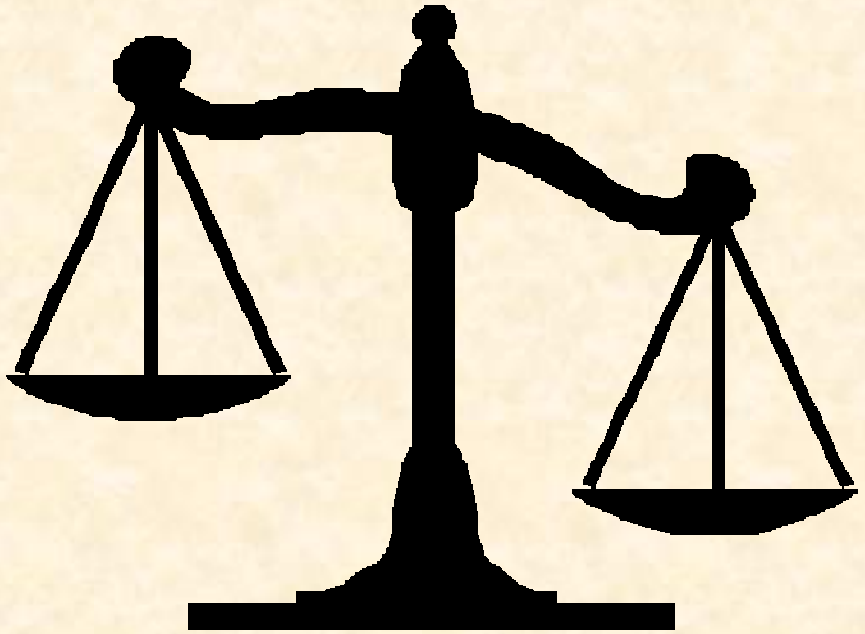
GEA Grasso's BluAstrum ammonia chiller:

- improved efficiency
- small dimensions
- low noise level
- improved control systems
- less and easy maintenance
- less complexity
- no oil pumps
- fewer connections

Energy-efficiency & refrigerant choice

Maximized climate benefits

Climate benefits from use of low GWP refrigerants and reduced leakage



Climate benefits from reduced energy consumption